4 Church Street
Maids Moreton
MK18 1QE

01280 816409
07858 367 125
murraybateman@geo-integrity.co.uk
www.geo-integrity.co.uk

Our Ref: MB/18-07-11

Infrastruct CS Ltd.
The Stables
High Cogges Farm
High Cogges
Witney
OX29 6UN

2nd August 2018

For the attention of Mr Tim Trotman

Dear Tim,

Drainage Comments – Land adjacent to A338 East Hanney, Oxfordshire.

Following receipt of the reports you forward to us and having looked into historical data by ourselves, we have pleasure in providing you with our comments, as chartered geologists, on drainage issues for the site adjacent to the A338 in East Hanney, Oxfordshire, centred at National Grid Reference SU420934.

Introduction

A number of different previous reports have been reviewed as part of this letter report, these are:-

- ListersGeo – Phase 2 SI for the site: ref. 16.08.015a
- MJA - Flood Risk Assessment for a Linden Homes Development on the adjacent side of the A338: ref 13/0623/4904
- WRA – Flood Risk Investigation for the site – June 2018
- Geo-Integrity – SI for site on adjacent side of the A338: ref 18-06-01

The objectives of this investigation were to compare the information from these reports to try to ascertain the ground conditions at the site and their effect on drainage as it exists now and potential methods of sustainable drainage should the site be developed.

Published Geology

Reference to the British Geological Survey website and Sheet 253; Abingdon; 1971; indicates that the site is directly underlain by Alluvium and Quaternary age Northmoor Sand and Gravel, overlying the Jurassic bedrock geology of the Kimmeridge Clay Formation.

Superficial

The Alluvium is associated with The River Ock to the northwest and associated local brooks. It would consist of unconsolidated clays deposited during flooding events. These may have sand and gravel bands within it but would largely be fine grained.

The Northmoor Sand and Gravel is a granular deposit from the Pleistocene age (Ice Age). Laid down in a higher energy environment, it is described as being “Dominated by clasts of Middle Jurassic limestone, but also containing a small proportion of "Bunter" quartz/quartzite and a varying proportion of flint, the latter increasing downstream below the confluence with the River Ock near Abingdon”. Being from the Ice Age it will be consolidated but heterogeneous. This would tend to be coarser grained and more permeable.

Bedrock

The Kimmeridge Clay Formation is an ancient sea-floor deposit and consists of dark grey organic rich silty mudstones that weather to grey and brown fissured clay with occasional siltstone and limestone bands. This deposit would be virtually impermeable.

Only the ListersGeo and Geo-Integrity reports have undertaken trial holes to any significant depths, and only the ListersGeo report on the site in question. However, the geology encountered is in accord with that described by the BGS maps.

Groundwater and Groundwater Flow

In both the intrusive investigations described above groundwater seepages were encountered within the granular Northmoor Sand and Gravel, just above the interface with the Kimmeridge Clay. This would be described as a perched groundwater table with levels being recorded at between 55.60m AOD and 58.78m AOD (or between 4.37m below ground level and 1.34m bgl). This indicates a general groundwater flow towards the north/ northwest, towards the Letcombe Brook, approximately 400m in that direction.

The WRA report does indicate that a piezometer tube was inserted into the ground to a depth of 1.08m bgl and recorded a water level at 59.55m AOD, however, details on the construction of the groundwater tubing were not included and if no seal was installed in the borehole this is likely to be acting as a sump for surface water draining in from ground level, as such the results of this piezometer have been dismissed. In addition, if groundwater were really at this level across the site the drain along the A338, and others in the area would be running.

Infiltration Rates of the Various Strata

BRE365 infiltration testing was undertaken in the Alluvium and the Northmoor Sand and Gravel as part of the Geo-Integrity report. Infiltration was very slow in the Alluvium, between 0.2m and 1.2m bgl, with an extrapolated result of $1.8 * 10^{-6}$ m/s. The tests undertaken in the top of the Northmoor Sand and Gravel (above the water table, with the base of the pit at a depth of 59.20m AOD) recorded infiltration rates of between $3.53 * 10^{-5}$ m/s and $1.4 * 10^{-5}$ m/s.

Infiltration testing was also done in the ListersGeo report within the Northmoor Sand and Gravel, this time below the groundwater level, so results needed to be extrapolated and recorded rates between $2 * 10^{-6}$ m/s and $1 * 10^{-7}$ m/s. It was described in the report that these lower results were likely due to infiltration being halted by existing groundwater level.

The MJA report recorded infiltration rates within the Northmoor Sand and Gravel as $4.24 * 10^{-6}$ m/s.

Also infiltration testing was carried out in the WRA report at depths of between 6cm and 4cm within the topsoil materials in June 2018, one of the hottest summer of recent times. The infiltration rates were recorded as high (10^{-4} to 10^{-5} m/s). However, it is considered that this would be explained by

desiccation cracks, which can reach down to 1.0m in hot dry periods on a clay soil, such as that on site.

Flooding Events and Ponding Effects of the Alluvium.

The site and immediate area have been documented to flood in the past and the EA flood risk map indicates an area of Zone 2 risk to the northeast of the site and Zone 3 areas to the west of the site, to the other side of Ebbes Lane. Photographs are included in the WRA report of surface water ponding in old field furrows on the site and flooding along roads, including Ashfields Lane to the south of the site.

The WRA attributes this flooding to a raise in groundwater level beneath the site, such that it daylights out of the ground. However, when you look at the groundwater level recorded during the ListersGeo investigation (approximately 58.8m AOD) and the ground level in the area of the field where ponding is noticed (approximately 59.8m AOD) there is a clear metre difference. When you compare this to the average rainfall over a year in this area of the country (from the Met Office website) being approximately 700mm, this cannot be the case. What is more likely to be the case; when you look at the low permeability of the Alluvium (as proved by BRE365 testing carried out by Geo-Integrity and ListersGeo); and the timeframe over which these events take place; is that a sudden storm event saturates the topsoil and leads to a ponding effect on the top of the Alluvium. This is due to it's low permeability not allowing rainwater to soak into the ground as quickly as it is being deposited (during a heavy storm event). This would be altered if a permeable link was set up between the top of the Alluvium and the top of the more permeable Northmoor Sand and Gravel below.

In addition the WRA report also indicates that the culvert that feed the ditch to the east of the site is some 4 or 5 times under capacity to deal with a 100 year rainfall event, some several hundred metres upstream. In addition, the level of vegetation in the ditch is such that it is likely to significantly increase the roughness and reduce the capacity of the ditch.

It is understood that the proposed development on the site would incorporate a hybrid drainage solution of infiltration with a high level overflow into the ditch.

Comments

Based on the evidence reviewed, it is considered that the ground model for the site would be a low permeability clay (approximately $1*10^{-6}$ m/s) associated with the Alluvium Deposits from ground level down to approximately 1.0m below ground level. The higher permeability ($5 * 10^{-5}$ m/s to $5 * 10^{-6}$ m/s) Northmoor Sand and Gravel is below this to a depth of between 1.60m to 2.0m bgl, with the impermeable Kimmeridge Clay below that.

Consequently, groundwater was located in the Northmoor Sand and Gravel at a depth of 0.15m to 0.30m above the interface with the Kimmeridge Clay, therefore there is between 0.30m and 0.70m thickness of Northmoor Sand and Gravel that is usually unsaturated above the groundwater table. The Northmoor Sand and Gravel is an extensive deposit, which extends to the Letcombe Brook both westward and northward and would be in hydraulic continuity with this water course.

The flooding events that have been recently documented in the village along Ashfields Lane are largely down to the poor state of the drainage ditches in the village and the inadequate size of culverts, it is considered from evidence put forward in the WSA report. In addition, it is thought, from the soakaway evidence in both the Alluvium and Northmoor Sand and Gravel that the ponding seen

on site has less to do with rising groundwater and more to do with the topography of the field and the low permeability of the Alluvium layer from ground level to 1.0m bgl.

As such, it is considered that a drainage strategy that involved the improvement of drainage ditches in the vicinity of the site and the low level soakage of surface water into the top of the Northmoor Sand and Gravel would be successful at this site, as it appears to have been at the Linden Homes development centred along Dandridge Close on the opposite side of the A338 (where the Northmoor Sand and Gravel is thinner and appears to be more clayey).

We trust this information is satisfactory to you. In the event of any queries please contact us.

Yours sincerely

Murray Bateman
Director, Geo-Integrity Ltd.